R. Larson

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COLOSSUS MEMO # 326 LUMINARY MEMO #233

TO: Distribution
FROM: Margaret Hamilton
DATE: November 23, 1971
SUBJECT: EMPs

Enclosed are memos which resulted from discussions on the contents and formats of EMPs.

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TO: DISTRIBUTION

FROM: K. W. Greene

DATE: 26 October 1971

SUBJECT: Erasable Memory Program (EMP) Control Procedures

REFERENCE: MISSION PROGRAM DEVELOPMENT NOTE #19 - EMPs

The purpose of this memo is an attempt to describe the procedures to be utilized for the development,verification, documentation and approval of EMP's. (See Reference 1)

The definition of an EMP is as follows:

"Specifically, it is any alteration to the erasable memory of the computer which causes the computer to execute instructions in a sequence not compatible with the program design and requirements (i. e. the GSOP). That is, if an alteration to the E-Memory causes a fixed memory program to skip or add steps, take a different route, etc., then that alteration comes under the category of erasable memory programming. This means that EMP's may be anything from actual machine code loaded into E-Memory to a flagbit change which causes some program to follow an abnormal logic path."

Because of the nature of EMP's and their mission dependence the normal procedures used for program development and changes thereto do not readily lend themselves to EMP's. To provide the proper control, the following is the first attempt to define the procedures that have been roughly outlined before at various meetings: (See Figure 1).

1. The origin of a proposed EMP may be at MIT/DL, MSC or any other agency. The proposed EMP is defined to the best of the originators capability on a PCR form. Thus proposed EMP descriptions may vary from just an idea to a complete proposal for an EMP depending on the originator.

2. The originator sends the proposed EMP in the form of a PCR to SFSB for MSC review. The PCR is then placed on an SCB agenda. For PCRs prepared outside of MIT/DL SFSB shall provide MIT/DL with a copy for review prior to the SCB.

3. The PCR is than brought before the SCB. At this point the concept of the proposed EMP is either approved or disapproved. (Block 4.0 of the PCR form is used for this action. See Fig. 2). Approval, is a letter of direction to MIT/DL to prepare, verify and document the proposed EMP.

4. After receipt of an approved EMP PCR (Block 4.0) the MIT/DL Colossus/Luminary/Skylark Project Manager and the Group 23B Division Director assign responsibility for the preparation of the EMP. This is accomplished by the distribution of completed "MIT/DL PROGRAM CHANGE ROUTING SLIP." Attached to a copy of the initial PCR. (See Figure 3).

5. After the EMP is developed and documented, copies of the PCR, and the documented EMP are distributed for review and verification. This step is accomplished by using "APOLLO/SKYLAB ERASABLE MEMORY PROGRAM VERIFICATION REPORT" for assignment of responsibility. (See Figure 4).

6. A MDRB (Mission Design Review Board) is then scheduled to review the comments and results of the verification effort. The comments received are negotiated and if approved by the MDRB they are implemented into the EMP documentation.

7. Copies of the EMP documentation are then sent to SFSB for review at MSC.

8. Comments received from MSC are reviewed at a MDRB meeting and the comments are implemented into the EMP documentation if agreed on at the MDRB.

9. Final copies of the EMP are sent to SFSB for action at an SCB Meeting. At this step the SCB will either approve or disapprove the use of the proposed EMP. Block 6.0 of the PCR is used for the recording of this action.

10. Approval as indicated in Block 6.0 of the PCR Form authorizes MIT/DL to publish the documentation of the subject EMP in Section 7 of the GSOP.

11. Changes to EMPs in Section 7 shall be accomplished via the procedures outlined above.

DISTRIBUTION:

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EMP CONTROL PROCEDURES FLOW

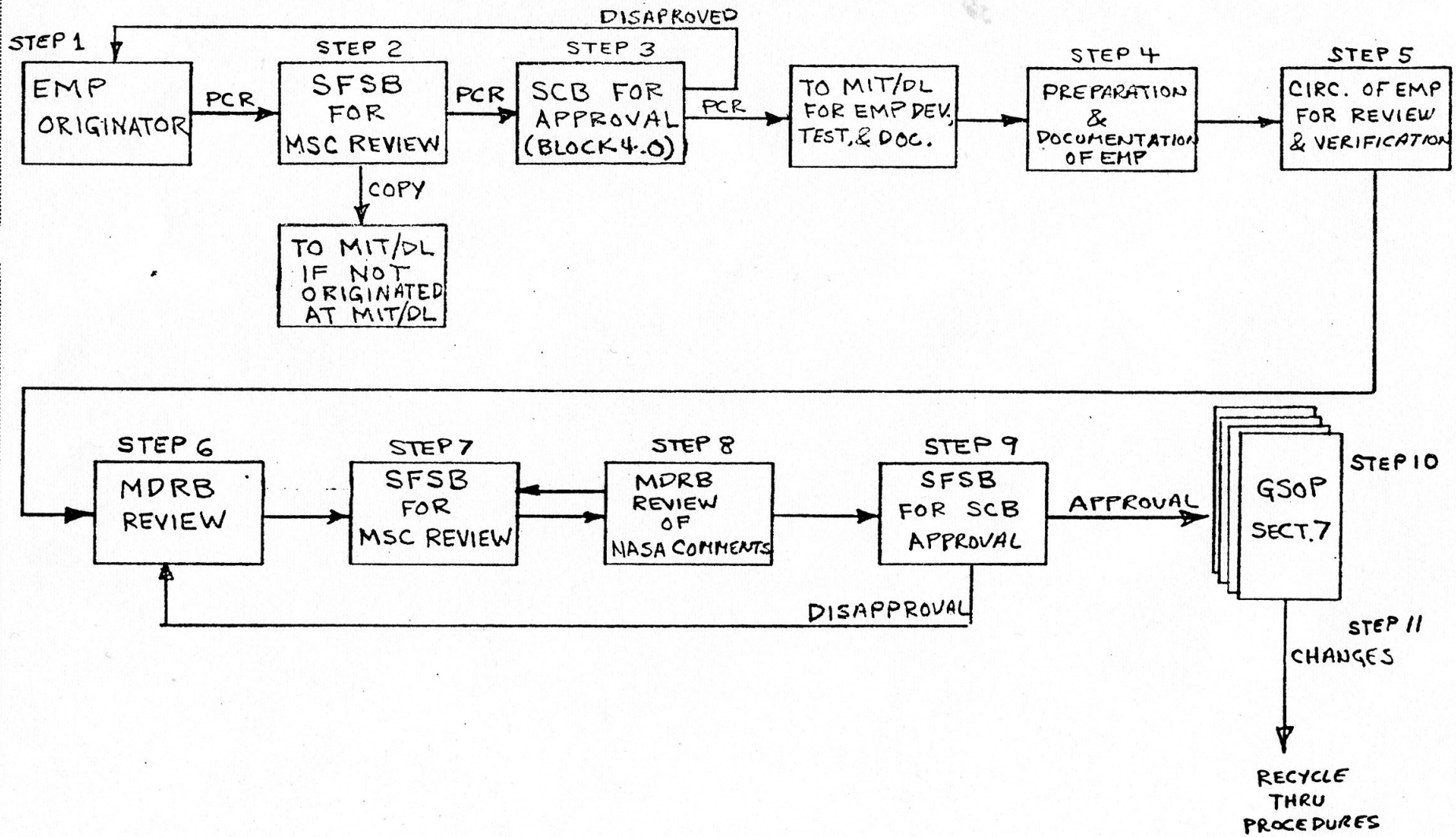

FIG. 1

SHEET NO. 1 OF 1
JOB NO.
SUBJECT EMP CONTROL PROCEDURES
DATE 10/27/71
DATE
BY K.W.G
HKD. BY

APOLLO SPACECRAFT SOFTWARE CONFIGURATION CONTROL BOARD PROGRAM CHANGE REQUEST

NUMBER (Completed by FSB)

1.0 COMPLETED BY ORIGINATOR

1.1 ORIGINATOR	DATE	1.2 ORGANIZATION	APPROVAL	DATE

1.3 EFFECTIVITY

1.4 TITLE OF CHANGE

1.5 REASON(S) FOR CHANGE

1.6 DESCRIPTION OF CHANGE

2.0 SOFTWARE CONTROL BOARD OR FLIGHT SOFTWARE BRANCH DECISION FOR VISIBILITY IMPACT ESTIMATE BY MIT

2.1 ☐ APPROVED ☐ DISAPPROVED

2.2 REMARKS:

2.3 SOFTWARE CONTROL BOARD OR FLIGHT SOFTWARE BRANCH SIGN OFF

DATE

3.0 MIT VISIBILITY IMPACT EVALUATION:

3.1 SCHEDULE IMPACT

3.2 IMPACT OF PROVIDING DETAILED EVALUATION

3.3 STORAGE IMPACT

3.4 REMARKS:

3.5 MIT COORDINATOR

DATE

4.0 SOFTWARE CONTROL BOARD ACTION

4.1 ☐ IMPLEMENT AND PROVIDE DETAILED CHANGE EVAL. ☐ PROVIDE DETAILED CHANGE EVALUATION ☐ DIS-APPROVED

4.2 REMARKS

4.3 SOFTWARE CONTROL BOARD SIGN OFF

DATE

5.0 MIT DETAILED PROGRAM CHANGE EVALUATION

5.1 MIT COORDINATOR

DATE

5.2 MIT EVALUATION

6.0 SOFTWARE CONTROL BOARD DECISION ON MIT DETAILED PROGRAM CHANGE EVALUATION

6.1 ☐ START OR CONTINUE IMPLEMENTATION ☐ DISAPPROVED OR STOP IMPLEMENTATION

6.2 REMARKS:

6.3 SOFTWARE CONTROL BOARD SIGN OFF

DATE

MSC Form 288 (Jul 68) TP#21812

FIG 2 6

MIT/DL PROGRAM CHANGE ROUTING SLIP

PCR/PCN # _____
ANOMALY # _____
SDR # _____

☐ COLOSSUS 3
☐ COLOSSUS __
☐ SKYLARK __
☐ LUMINARY 1E
☐ LUMINARY __

☐ MIT Approved PCN
☐ MIT Approved SDR
☐ NASA Approved PCR
☐ NASA Approved PCN
☐ NASA Approved Software Anomaly
☐ MIT Approved Software Anomaly

A. Coding

◯ Begin coding immediately _____

ACTION: _____

Program Supervisor's Approval: _____

◯ Do not code until new GSOP material has been approved by the MIT Mission Design Review Board (MDRB) and distributed.

B. GSOP Preparation

◯ Prepare GSOP revisions for MDRB consideration _____

ACTION: _____

☐ Technical Committee Meeting not required.

☐ Technical Committee Meeting(s) held on _____
Attendees:

C. KSC Testing and Checkout

◯ Review for possible impact on KSC testing and checkout ACTION: _____

D. Other Programs Affected

◯ Review for corresponding changes in _____

ACTION: _____

Special Instructions

Project Manager _____

Date _____

FIG. 3

FIG. 4

APOLLO/SKYLAB ERASABLE MEMORY PROGRAM VERIFICATION REPORT

PCR NO: _____

EMP NO. _____

I. VERIFICATION OF EMP FOR MISSION _____

II. VERIFICATION IS TO BE CONDUCTED USING _____

III. VERIFICATION OF THE EMP AND REVIEW OF THE SECTION 7 GSOP DOCUMENTATION SHOULD BE CONDUCTED BY YOUR GROUP TO ASSURE THAT THE EMP LISTED ABOVE IS A PROGRAM THAT HAS BEEN TESTED AND FOUND QUALIFIED FOR FLIGHT UTILIZATION.

Please summarize tests conducted and any pertinent comments below. If testing of this EMP is not applicable to your area, indicate this by (N A).

Project Manager _____

Date _____

COMMENTS

Responsible Eng.	Qualified Sign. _____ Date _____
Ass'y Supervisor	Qualified Sign. _____ Date _____
Prog. Supervisor	Qualified Sign. _____ Date _____
23D MPV Supervisor	Qualified Sign. _____ Date _____
23S Sys. Engr. Supervisor	Qualified Sign. _____ Date _____

Return Completed Form to K. Greene DL7-277 MS 23

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MISSION PROGRAM DEVELOPMENT NOTE #19

TO: Distribution
FROM: M. Hamilton
DATE: October 18, 1971
SUBJECT: EMPs

A meeting was held to decide on the following:

1) EMP format and content changes
2) Procedures for handling EMPs
3) Negotiation of EMP schedules
4) EMP review form changes

Attendees: J. Reed
P. Rye
R. Larson
D. Millard
B. McCoy
M. Hamilton
P. Volante
K. Greene

A new section of the GSOP (section 7) is being created for the purpose of specifying erasable programs. Each new erasable program (EMP) will be generated by a PCR. Ken Greene will describe the procedures for reviewing PCRs and resulting EMPs in a forthcoming memo. Discussion and decisions made at the meeting are:

1) The format of the EMP will be changed to the following:

a. Purpose
*b. Functional Description
c. Assumptions

*added sections

d. Restrictions and Limitations
e. Procedures
*f. Recovery/Termination
g. Erasable /Memory
h. Uplink

2) The functional description section was added in order to clarify how the existing software is affected by the erasable program. For instance, if T4RUPT is affected, it should be mentioned in this section. Also, flow charts should be included here if necessary to show the EMP logic.

3) The Recovery/Termination section was added to include
a. recovery procedures for restarts or other problems and
b. a way of terminating the erasable program. Termination might be accomplished by restoring the rest of the program back to the way it was, e.g., restoring flagbits or turning off a cyclical erasable program. In the future, we should design EMPs to allow for a safe termination procedure. An example would be to have a flagbit in the EMP logic, which in one state would keep an erasable program cycling and in the other state would turn off the erasable program. In the past, we made mistakes such as changing an erasable in the logic sequence of an erasable program on the fly via V21. This is obviously a dangerous practice for either starting up an EMP or terminating one.

4) MDRB meetings will be held by the project manager with individuals from appropriate divisions. The new EMP form will include the date of the MDRB meeting. This in essence, means that the EMP should have been reviewed and tested before the MDRB meeting. All changes to be made to the EMP will be ironed out in the MDRB meeting.

* added sections

5) Engineers assigned to code EMP PCRs will submit a formatted copy of their assigned erasable programs to Jack Reed after the program is thoroughly tested. A sample format will be sent to engineers, along with a PCR showing how EMPs are filled out. (see attached "dummy" of EMP)

6) Section 7 will contain a qualifying statement to the effect that all EMPs are assumed to be in conflict with other EMPs unless stated otherwise. A matrix will be provided at the beginning of section 7 showing relationships between EMPs.

7) Even though some EMPs were reveiwed and checked out for APOLLO 16, a new review effort should be made in order to guarantee that new mission procedures are compatible with the EMP. Also, it might be possible that an EMP will have to be changed to run with another EMP. In addition, the added new documentation for section 7 should be reviewed on existing EMPs.

8) Schedules are yet to be defined for EMPs submitted after Sept. 15.

DUMMY

EMP XXX: Name of Erasable Memory Program

PURPOSE:

EMP XXX provides a means of .....
(Describe – usually in one sentence – the specific task performed.

ASSUMPTIONS:

EMP XXX is used when .....
(Describe the vehicle and G & C status or preconditions appropriate to the use of this erasable program.)

FUNCTIONAL DESCRIPTION:

(Provide functional diagram of the program, with verbal amplication if appropriate – GSOP Section 4 information).

RESTRICTIONS AND LIMITATIONS:

(Specify times, conditions, and states when the use of EMP XXX is proscribed. Identify potential areas of conflict with other programs. If the program is not restart protected, state the possible effects.

PROCEDURES:

(Use imperative mode to present step-by-step procedure for setting up, activating, and performing EMP XXX. Use notes, if necessary, to describe operational subtleties.)

RECOVERY/ TERMINATION:

(Use imperative mode to present step-by-step procedure for terminating EMP XXX and restoring the AGC to its original configuration. If program is not restart protected, describe restart recovery.)

ERASABLE
MEMORY: (Present actual program coding for EMP XXX)

Location	Tag	Code	Octal

UPLINK: Present uplink format for loading EMP XXX)

Load 1	Load 2 - - - - - - - - - - - - - - - -	Load n